IN THE UNITED STATES DISTRICT COURT
FOR THE MIDDLE DISTRICT OF PENNSYLVANIA

METSO PAPER USA. INC.	:	CIVIL ACTION – LAW
Plaintiff,	:	
	:	NO.: 3:08-cv-47
v.	:	
GENERAL ELECTRIC COMPANY	:	
Defendant.	:	JURY TRIAL DEMANDED

EXPERT PROFFER RELATED TO HARRI KYTOMAA

Harri Kytomaa will provide the following testimony and opinions to a reasonable degree of engineering certainty:

1. Harri Kytomaa is a Corporate Vice President and Director of the Thermal Sciences Practice at Exponent. He specializes in mechanical engineering and the investigation of fires and explosions. He has a PhD and Masters in Mechanical Engineering from the California Institute of Technology. He has a Bachelors of Science in Engineering Science from Durham University in England. (*See* Exhibit 1).

2. Dr. Kytömaa investigates fires and explosions and applies his expertise to determine their cause and origin. He also applies his expertise to the investigation and prevention of failures in mechanical systems, including combustion equipment. Dr. Kytömaa also investigates such failures in aircraft, motor vehicles, marine facilities, industrial and manufacturing complexes, and office and residential occupancies. Dr. Kytömaa's project experience includes turbines, compressors, boilers, smelters, pneumatic and hydraulic systems, instrumentation, nuclear waste management, heat transfer systems, flammable vapors, flammable liquids, CO formation and migration and cryogenic liquids including LNG and its associated equipment.

   Dr. Kytömaa has held several academic, research, and consulting positions, including that of Associate Professor of Mechanical Engineering at the Massachusetts Institute of Technology where he was head of the Fluid Mechanics Laboratory. He has also held positions as Visiting Professor at the Helsinki University of Technology and at the DOE Pacific Northwest Laboratory in Washington, served as Lecturer in the Department of Mechanical Engineering at the Massachusetts Institute of Technology and most recently, at the Worcester Polytechnic Institute.

3. In November 2002, Metso Paper decided to upgrade and replace the existing lighting at their Clarks Summit, PA facility. Andrew Kuzmick, lighting sales engineer, proposed the use of 48 Hubbell Tribay fixtures with open reflectors (i.e. no lens covers) using GE MVR750/VBU/PA 750W Metal Halide lamps for this application. Metso placed an order for the lamps in December 2002 which were delivered to the Clarks Summit facility and installed in February 2003. After the installation of these lamps, Metso operated these lamps continuously starting Monday morning to Friday afternoon, when they were turned off at close of business. The lamps were also operated over the weekend for short periods of time on a regular basis. (*See* Exhibit 2).

4. In 2004, Metso had the ballasts on all the 750W lamp fixtures replaced after loud buzzing was heard from some of the fixtures. During the period following the installation of the new lighting system, there is no indication that Metso kept track of lamp usage hours, nor did Metso have a group-relamping program in place at the time of the fire.

5. On January 21, 2006, Metso personnel working at the facility noticed a fire on materials stored on a rack at their facility. They attempted to put out the fire using fire extinguishers. The fire was eventually put out by the local fire department.

6. Subsequent investigations allege that the fire was started due to the rupture of an operating GE 750W Metal Halide lamp. Hot particles from the lamp rupture are alleged to have ignited combustible materials stored in the vicinity of one of the lamps. The lamp was recovered from its fixture after the fire and stored as evidence. However, the fixture in which the lamp was installed was discarded by Metso.

7. Metal Halide (MH) lamps, a type of High Intensity Discharge (HID) lights, produce light by an electric discharge that excites a mixture of mercury vapor and the products of the dissociation of halide salts of different metals. The metallic mercury and metal halide salts are contained in a transparent cylindrical arc tube that is made of quartz. The arc tube is enclosed in an outer glass bulb that is filled with an inert gas.

8. Kytomaa intends to show a figure depicting the construction of a typical metal halide lamp. The Figure is attached as Exhibit 3.

9. During use, the arc tube operates under high pressure and high temperatures (as high as 1100°C). (*See* Exhibit 4).

10. Metal halide lamps offer good color quality and operate at high efficiencies over a long life when compared to other lighting technologies. (*See* Exhibit 5).

11. Kytomaa intends to show a table comparing the typical efficiencies, in lumens per watt (lpw), and rated life of different lighting technologies. The table is attached as Exhibit 6.

12. MH lamps have particularly high energy efficiency and therefore a corresponding low cost of operation. (*See* Exhibit 7).

13. In addition to their high energy efficiency and good color, metal halide HID lamps provide additional benefits. (*See* Exhibit 8- CONFIDENTIAL).

14. The more natural lighting afforded by metal halide lamps contributes to workplace safety over other widely used HID lamps such as high pressure sodium lamps (HPS). HPS lamps are used widely over roadways, parking lots and warehouses, but they emit a yellow-orange light.

15. The yellow-orange light from HPS lamps may be acceptable in parking lots, but it hinders one's ability to perceive color in color coded packaging, signs or reading colored instructions in an indoor or outdoor environment.

16. The natural light and color contrast of MH HID lamps reduces worker fatigue in comparison with environments that are lit using HPS lamps. (*See* Exhibit 9).

17. When an HID lamp reaches the end of its operating life, in the overwhelming majority of cases it passively ceases to emit light.

18. In rare circumstances, the HID lamp can shatter during operation, producing hot quartz particles. Such an event is called a "non-passive failure" or NPF in the industry. (*See* Exhibit 10).

19. The risk of NPFs is extremely low if the user replaces the lamp before its rated life and increases when the lamp is operated beyond its rated life instead of replacing it. (*See* Exhibit 10).

20. There are applications where the risks posed by the small chance of hot particles being emitted can be acceptable. Examples of such applications include environments that do not pose a risk of fire. For such applications, the most efficient, most easily maintained, and the lowest cost lighting solution is provided by S-rated lamps operated in open fixtures. (*See* Exhibit 10).

21. The risks associated with S-rated HID lamps are substantially under the control of the user. The HID lamp user is specifically instructed to reduce this low risk of an NPF by a variety of measures. (*See* Exhibit 11).

22. GE recommends that the lamps not be located over combustible materials and that the lamps be group-replaced prior to the end of their rated life instead of running each bulb to failure. (*See* Exhibit 4 and 12).

23. Manufacturers, including GE, publish rated lives for each lamp model. The rated life of metal halide lamps is based on laboratory tests of a large number of lamps under controlled conditions and cycling the lamps on for 10 hours per start. The rated life is the median life of the tested population of lamps. In other words, rated life is the time after which 50% of the tested lamp population is still working. Many factors inherent in the lamp manufacture and usage introduce variability in the life of individual lamps. The

operating life of lamps can vary significantly from its published value depending on its usage and the environment it is used in. (*See* Exhibit 8 and 13).

24. The rated life of the GE 750W metal halide lamp involved in this incident is 16,000 hrs. (*See* Exhibit 7).

25. For this type of lamp, GE predicts that the life of a lamp will be shortened significantly if they are operated on cycles shorter than 10 hours. For example, operation of these lamps on a 5 hours per start cycle reduces their expected life to approximately 75% of the published value. (*See* Exhibit 4).

26. Metso paper used the GE lamps on weekends regularly where the lamps were kept on for less than 10 hours each time, thereby shortening their expected life.

27. Metso also operated the lamps during the work week on a cycle that was significantly less than 120 hours per start.

28. These estimates of Metso's lamp operation history are based on various sources including plaintiff's own expert Randy Marshall's report, David Kuzmick's deposition and other material produced during discovery.

29. Metso paper did not have a group relamping program in place to replace these lamps before the end of their rated life as is recommended by GE. The information regarding the lamps' rated life was provided to Metso in the form of a 2 page cover document as part of Andrew Kuzmick's lighting proposal. (*See* Exhibit 7).

30. The incident lamp was manufactured in May 2002 and installed at Metso's facility in February 2003.

31. Under the operating conditions represented by Metso, the lamp that failed reached the end of its rated life of 16,000 hrs in September, 2005, four months prior to the incident in January, 2006.

32. Metso kept their MH HID lamps on from Monday to Friday and often turned them back on for one or more short durations on the weekends.

33. Metso's weekly operation of the GE 750W lamp was such that the expected median life of their lamps would likely have been lower than the 16,000 hrs presented by GE.

34. GE's Lamp Products Catalog 2001-2002 and Lamp Products Catalog 2006 provide information about the median life of the subject lamp. (*See* Exhibit 8).

35. Metso did not keep track of the burning hours of the incident lamp or any other lamp at their facility and, at the time of the incident, did not have any program in place to replace the lamps as a group to ensure safe and efficient operation of their light fixtures.

36. Metso's failure to replace lamps before the end of their rated life was in direct violation of all industry and manufacturers' recommendations that were easily accessible to Metso paper and their contractors who specified, sold and maintained the lighting system

37. MH lamps have fixture requirements that must be followed for safe operation of the lamp depending upon the application in which the lamp is to be used.

38. Lamps that are rated "O" have an internal shroud and can be operated in an open or enclosed fixture. (*See* Exhibit 8).

39. Lamps with an "E" rating may be operated only in an enclosed fixture that is designed to contain fragments of hot quarts or glass that may be emitted from the lamps. (*See* Exhibit 8).

40. Lamps with an "S" rating may be used in open or enclosed fixtures, but they may be used in open fixtures only if they are operated in a vertical ±15° burning position. Used in any other orientation, the lamps must be suitably enclosed. (*See* Exhibit 8).

41. The GE 750W lamp used at the Metso facility was S-rated. It was designed to be operated in a vertical base up position in an open enclosure. For locations where combustibles are present, GE recommends the usage of enclosed fixtures with S-rated lamps. These are designed to contain the hot fragments of the arc-tube in the rare event of a lamp rupture.

42. To this day, Metso continues to operate lamp fixtures with open fixtures and bulbs that are not O-rated at their facility in Clarks Summit, PA where this incident occurred. (*See* Exhibit 13).

43. Kytomaa intends to show photographs he took of Metso's usage of lamp fixtures with open fixtures and bulbs that are not O-rated at their facility in Clarks Summit, PA. These photos are attached as Exhibit 13 and were taken at Metso's Clarks Summit, PA facility on April 8, 2010.

44. Metso increased the level of lighting in their warehouse significantly when they installed the GE 750W metal halide lamps. Despite the increased level of lighting, the GE 750W lamps achieved substantial savings in the annual cost of lighting the warehouse. Their savings in energy costs allowed for the initial capital expenditure associated with the installation of the new GE metal halide lights and fixtures to be paid back within 2.5 years. Following this pay-back period, Metso would have benefitted from substantial annual savings in lighting costs. (*See* Exhibit 14).

45. GE and all other major HID lamp manufacturers make and sell S-rated lamps.

46. These cost less than O-rated lamps. Similarly, fixture manufacturers make and sell open fixtures that also cost less than enclosed fixtures.

47. To minimize the initial capital expenditure associated with the light fixtures, Metso and the lighting design engineer, Andrew Kuzmick, chose open fixtures and S rated lamps for the Metso warehouse.

48. Only the owner and operator of the warehouse have the knowledge and the control over the warehouse environment. This places the responsibility of selection of fixtures and lamps and their maintenance and operation solely on the end user, Metso, who should follow the manufacturer's guidelines and recommendations.

49. For applications where even a small risk of exposure to hot arc-tube particles is not acceptable, O-type bulbs that contain these particles are available as are enclosed fixtures, but at added cost.

50. The balance between risk and cost savings can only be managed by the end user, Metso, who must choose the lighting components in a manner that keeps risk at an acceptably low level while managing the cost of their operation.

51. Metso chose a combination of fixtures and lamps that provided significant cost savings in lighting the warehouse.

52. The S-rated GE750W lamp is particularly attractive due to its low operating costs.

53. Industry should not be denied access to this product, the cost savings it provides and its other advantages for the many applications where it can be used with an acceptably low level of risk of fire or injury.

54. In this case, Metso overlooked the recommendations provided by GE and used S-rated lamps in the presence of combustible materials and chose to operate the lamps beyond their rated life instead of group-relamping at or before the end of their rated life. (*See* Exhibit 15).

55. Kytomaa intends to demonstrate the cost savings associated with the S-rated lamps and the additional cost that would be incurred in using O-rated lamps or enclosed fixtures. Such costs should not be imposed onto end-users in applications where S-rated lamps and open fixtures present an acceptably low level of risk of fire or injury.

56. Kytomaa's lighting cost analysis is attached as Exhibit 16.

57. Enclosures or bulbs that can contain hot particles necessarily create additional optical barriers to the light emission and additional physical barriers to cooling of the bulb, causing the bulb to operate at higher temperatures. These factors tend to reduce the amount of light from the fixture and tend to shorten bulb life.

58. As a result of the reduction in light from enclosed fixtures, more fixtures need to be installed to provide the same amount of lighting in comparison with open fixtures.

59. In order to maintain the same amount of light as the system chosen and installed by Metso, the number of covered 750W lamp fixtures installed would have to have been increased by 4 bringing the total number of lamp fixtures that Metso would have had to purchase to 52. (*See* Exhibit 16).

60. Installation of 52 enclosed light fixtures instead of 48 open fixtures by Metso would have increased their initial capital expenditure by almost $2500 and increased their annual operating costs by $1500. This increased number of lamps still provides a saving in energy over the pre-existing lighting configuration in 2002, but a smaller one. Their annual savings in energy costs would have paid for the initial capital costs of the system over a period of 4.5 years, two years longer than the system that Metso installed with S-type lamps only. (*See* Exhibit 16).

61. The lens of enclosed fixtures requires additional maintenance, since it will collect dust, insects and other debris. This adds to the maintenance cost.

62. The additional maintenance and cleaning of enclosed fixtures also brings about new risks that do not exist for the unenclosed fixtures.

63. Cleaning the lens of an enclosed fixture requires service personnel to regularly climb to the elevation of the luminaire, via ladder, lift, or other elevated platform, all of which increase the risk of injury.

64. 750W metal halide bulbs that are O-rated were not available at the time of the original installation. Had Metso chosen the available O-rated 1000W lamps for their installation, a smaller number of lamps and fixtures would have been needed. As a result, the initial capital costs associated with these lamps would have been higher by $750. (*See* Exhibit 16).

65. The O-rated lamps cost more, but are also less efficient in that they create less light for the same amount of electricity. As a result, the annual operating cost of this system would have been higher by $2,800 compared to the 750W system that Metso put in. This increased capital cost and substantially higher operating costs would have required Metso to operate the system for more than 6 years (4 years more than the GE 750W bulb system) to recoup their capital cost, making this lighting system a comparatively greater overhead burden on the facility. (*See* Exhibit 16).

66. Virtually all products, including electrical products, have some risk associated with their use. A "safe" product is not a "risk free" product. Rather, the definition of "safe" is "acceptable risk." Risk is measured in terms of frequency and severity.

67. Almost every product or device can be made "safer," *i.e.*, with a lower risk, by designing features into the product that reduce the risk of failure. This almost always makes the product more expensive, less convenient or both. As a society and as users of products we balance cost and risk.

68. Merely presenting more risk to the user does not make a product "unsafe" or "defective." The market has never demanded, and should not demand, that all product users always use the lowest risk product. To require this would lower everyone's standard of living because a lower risk product, absent a technology change, is almost always more expensive.

69. There are no risk free light sources. All existing lighting technology takes energy, usually in electrical form but sometimes in thermal or chemical form, and converts a fraction of that energy into visible light. There is always risk associated with the use of significant energy for any purpose, including lighting.

70. As is often the case with very low risks, the small risk of NPF poses a substantial technical challenge in quantifying just how small it is. The yearly rate of HID lamp induced fires is so low that it is subject to considerable statistical uncertainty.

71. To put the risk of a metal halide lamp NPF resulting in fire for metal halide lamps into perspective, it is much smaller than the risk of a lightning strike resulting in fire. It is extremely rare, but GE still instructs end users to take specific measures to reduce this very small risk.

72. It is estimated that nationally there are 46 million HID luminaires of which about 30 million are metal halide luminaires. It is estimated that, in 2000, a total of about 35 million HID lights were sold in the US of which metal halide lamps numbered 19.5 million.

73. In the three decades that HID lamps have seen wide spread use, lamp NPFs that have been claimed to have resulted in a fire have numbered in the few dozen. The fraction of these claims that were objectively determined to have actually resulted from an NPF is unknown, but very small.

74. Examination of the millions of records of fire data in the National Fire Incident Reporting System (NFIRS), in the period between 1999 and 2006, filled out by responding fire departments nationwide and compiled by the National Fire Administration showed that eight warehouse fires were listed as having been caused by HID lamps and their fixtures. This included fires reported due to mercury vapor, sodium vapor, metal halide lamps and their respective fixtures. This also includes fires caused by ballasts. The number of fires caused by lamps alone is therefore expected to be less than 8.

75. In the same period, more than 150 fires in warehouses and similar industrial structures were reported as a result of lightning strikes.

76. Examination of the NFIRS data shows that warehouses are at far greater risk of fire from other causes associated with building utilities, such as their heating and ventilation equipment.

77. Heating and ventilation equipment installed in warehouses accounted for 415 fires compared to the 8 fires that were attributed to HID lights and their fixtures in the data collected between 1999 and 2006.

78. The GE MVR750/VBU/PA 750W Metal Halide lamp is not a consumer product and is used in commercial and industrial locations.

79. GE's product literature for the 750W metal halide lamp involved in the incident, as well as their lighting catalogs warned of potential damage due to the improper use of HID lamps. These materials also specified the rated life of the lamps and recommended that group relamping be done before the end of rated life of the lamps. (*See e.g.* Exhibit 8 and 12).

80. Information regarding the rated life and relamping of lights prior to the end of their rated life was provided to Metso well before Metso purchased the lights. This information was provided in the form of a short 2-page brochure with the lighting proposal prepared for Metso by Andrew Kuzmick. (*See* Exhibit 7).

81. In addition to the information in GE's catalogs and marketing materials, there was and is widely available literature concerning the small risk associated with nonpassive failure and how to virtually eliminate that risk (*E.g.*: NEMA LSD 25: Best practices for Metal Halide Lighting systems, the IESNA lighting Handbook). (*See e.g.* Exhibit 11).

82. Even as early as 1998, insurance industry bodies like Industrial Risk Insurers (IRI) recommended that HID light fixtures not be located above areas where combustible materials are present. They also suggested that users maintain records of lamp operating hours and implement group relamping practices before the end of their rated life. IRI also recommended compliance with manufacturers' guidelines to reduce the risk of fires due to nonpassive failures of metal halide lamps.

83. Commercial insurance companies, like FM Global, in 2002 also suggested that their insured customers follow the requirements shown on manufacturers' bulletins and recommended that users replace their lamps prior to end of rated life by group relamping.

84. It should have been clear to those responsible for maintaining the lights in this warehouse that the MH lamps must be replaced at, or prior to, the end of their rated life in order to minimize the risk of nonpassive failure. It is most effective to replace lights in groups (group relamping) to eliminate the possibility that any one light is used beyond its rated life. It was also clear by 2002 that open metal halide fixtures should not be placed over combustible material and that either protected lamps (shrouded) or lens covers should be used in such applications. These measures were particularly important in light of the fact that Metso ignored GE's and the industry's recommendation to relamp at or prior the end of the rated life of the lamps, and to replace all lamps at once.

85. The opinions offered by Dr. Kytomaa require specialized knowledge in the field of mechanical engineering and thermal sciences. The opinions will assist the trier of fact

understand the design of the GE 750W Metal Halide Bulb along with the various applications and functions of the designs. The opinions will also assist the trier of fact understand the design in the context of an overall warehouse environment. The opinions will also assist the trier of fact understand the thermal issues related to the design of the bulb. The opinions will be offered to a reasonable degree of scientific or engineering certainty and are based upon facts and data provided by Metso Paper employees, GE documents, and industry and engineering materials. Kytomaa relied upon principles of mechanical engineering and thermal science and applied them to the facts of the case.

Respectfully submitted,
GENERAL ELECTRIC COMPANY,
By Its Attorneys,

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DATED: May 29, 2012

CERTIFICATE OF SERVICE

I hereby certify that I served a copy of this document on all parties of record on May 29, 2012 filing with the ECF system, which serves all counsel of record. The document is available for viewing and downloading from the ECF system.

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